

BREAKOUT GROUP (BOG) 2 REPORT: USER AND APPLICATION REQUIREMENTS, INCLUDING END-TO-END ISSUES

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1 OBSERVATIONS

Several comments regarding the characteristics and requirements of high-end applications, e.g., remote bioimaging and high-energy physics, were presented during the Panel 2 discussion on the second day of the workshop. Here is a list of some that seem worthy of inclusion as part of this BOG report:

- Latency, not bandwidth, is often the major issue.
- Most applications will always need IP.
- Transport-layer transparency is required over hybrid networks (e.g., networks involving both lambda switching and high-speed packet-switching).
- Access to high-data-rate instruments is a driver for optical network applications, both for lambda-switched networks and for hybrid networks.
- Applications require access to large distributed data sets (varying up to petabytes of data).
- Special applications (e.g., telesurgery, crisis mitigation) need non-shared networks, to avoid the jitter and packet loss that might result from competition for resources.
- Some application users form large global virtual organizations (e.g., high energy physics with 5000+ physicists, 250+ institutes, and 60+ countries).
- Worrying about full utilization of resources for all applications is a waste of energy; e.g., instead of worrying a lot about compressing HDTV, devote time and energy to security and just run uncompressed HDTV.

2 DISCUSSIONS

Discussion leaders opened the BOG 2 session by presenting a draft set of recommendations for agency programs to support application users of optical network testbeds. These recommendations formed the basis of the BOG discussion; the final version is as follows, with associated issues and questions.

2.1 Discussion Topics

2.1.1 Deployment of optical networks for selected research projects

- a. What projects or research efforts require optical networks and on what time scales (utilization)? How multidisciplinary? Investigate and evaluate novel technology, tools, diagnostics and security.
- b. Where is the cut-off, what are the criteria to justify deployment? One-time and continuing costs should be compared to the fraction of the overall project cost and fees for scaled-up shared networks.
- c. Innovation for application and network scaling.

2.1.2 Establishment of a multi-agency “optical connections” program

- a. Small number of players at outset; ability to scale is important.
- b. Driven by applications and need for optical network capabilities.
- c. Cross-agency network management and diagnostic tools development and deployment.

2.1.3 Development of hybrid network testbeds (optical, wireless and IP)

- a. Future networks will not be monolithic.
- b. Interoperability, transparency are essential.
- c. Network-aware applications/networks that can advise applications.
- d. Many applications require such capabilities: sensors, disaster, health, sharing HPC, outreach, etc.

2.1.4 Development of optical “morphnet” networks bridging advanced research and early “production” networks

- a. Dual synergistic approach: network research and domain research.
- b. Provide entry and access for providers.
- c. Applications inform network architects and providers.
- d. Technology transfer process more implicit.

During the BOG discussion of these recommendations, several areas were discussed at length. The remainder of this report presents the major highlights from these discussions.

2.2 Involving the user community

Everyone agrees that Federal optical networking programs must involve the application user community. It was noted that it is difficult to get domain scientists to use unproven

technologies. Perhaps the Federal government agencies can accelerate user participation in a manner similar to the role the Feds played in the development of supercomputing facilities in the 1980s and 1990s. The domain communities need to learn what is available; perhaps the Federal agencies could facilitate the access of high-potential users to the optical networks, in addition to the current “heroic” users.

Frequently, campus infrastructure limits scientists' access to optical networks or testbeds. Agency help may be needed to provide incentives to motivate campus computer centers to provide fiber/wavelength access to users.

It was noted that there is a need to redirect the research of the academic community to focus more on real application implementations rather than simulation, especially as it relates to optical networks and testbeds.

A funding model similar to vBNS (i.e., using the vBNS model as a starting point, taking account of vBNS lessons learned, and factoring in today's constraints and requirements) was suggested to address the issue of who pays for the networks at the conclusion of the research project and as a way to encourage experimentation and leading-edge applications. The importance of getting industry involvement was recognized.

2.3 Application requirements for resource management and measurement

The need for both network-aware applications and for a network that can provide advice to applications to enable them to adapt to network characteristics was discussed. Requirements and/or suggestions that were offered include the following:

- Adaptability of underlying system infrastructure
- Dynamic provisioning of resources
- Automatic identification of problems by network measurement tools
- Standard way to report network measurement results
- Dynamic, scalable services, scalable to 10 Gbps and beyond
- User self-reporting of network (or system) performance
- Use of agent-based services for managing global systems

2.4 Control plane and infrastructure issues

The BOG discussed whether applications should be provided access to the control plane. Many felt that applications need to control their own resources, implying that they need access to both the control plane and the management plane. Security implications of giving control plane access to applications need to be determined and addressed.

It was noted that an open router architecture is needed for implementation testing of some new technologies, such as the XCP transport protocol. In addition, it is desirable to have a single switching/routing element for both local-area and wide-area networks, rather than one for each different environment.

2.5 Other recommendations for Federal agencies

- It would be useful for the Federal agencies to catalog optical networking resources.

- A good coordination function for agencies and partner organizations would be to track the utilization of the optical network testbeds, including keeping track of what facilities are available and how they can be used.
- Federal agencies can provide multi-disciplinary incentive.
- Federal agencies should encourage the development of an optical network “connections” program.

3 OVERALL BOG 2 RECOMMENDATION

Agencies and partner organizations should work together aggressively to use real applications as drivers for optical internetworking, and to develop a multi-agency connections-type program to enable applications that require optical networks.

Optical networks are fast becoming the “new” new thing in high performance internetworking; therefore agencies and partner organizations should provide incentives for real science and application users to get involved in order to effectively drive the optical network testbeds and the research and education (R&E) early production optical networks in this vital area. This will assure that the resulting infrastructure of interconnected networks will meet the true requirements of demanding existing and future agency “e-science” and government applications. The BOG 2 discussions (see above) should be used as a springboard to get started quickly.